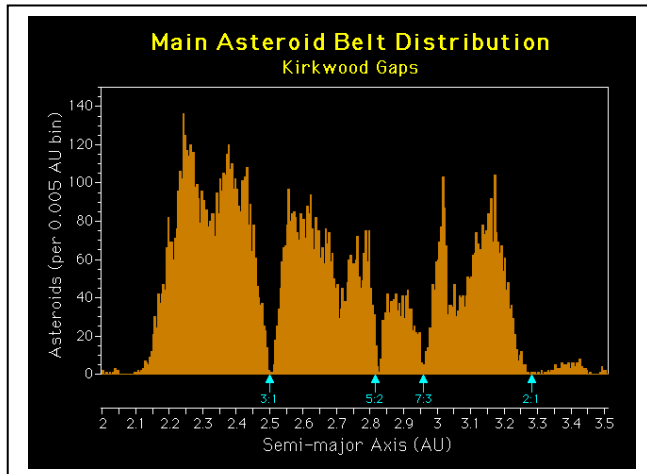


Fractions in Space



Simple fractions come up in astronomy in many ways. One common way is shown to the left. The asteroids in the Asteroid Belt have gaps where their orbit period is a simple fraction ($3/1$, $5/2$, or $2/3$) of Jupiter's orbit period.

Here are a few other 'far out' examples!

1 – The satellites of Jupiter, Ganymede and Europa, orbit the planet in 7.1 day and 3.5 days. About what is the ratio of the orbit period of Europa to Ganymede expressed as a simple fraction involving the numbers 1, 2, 3 or 4 in the numerator or denominator?

2 – The planet Pluto orbits the sun in 248 years while Neptune takes 164 years. What is the simplest fraction involving the numbers 1, 2, 3 or 4 in the numerator and denominator that approximates the ratio of Neptune's period to Pluto's?

3 – Draw two concentric circles labeling the outer circle Earth and the inner circle Venus. Place a point on each circle at the 12 o'clock position, representing the two planets closest to each other. Venus and Earth are opposite each other in their orbits every $3/2$ of an earth year. During this time, Venus travels $6/5$ of its orbit around the sun. Where will the planets be after 5 opposition periods, and rounded to the nearest integer year, how many Earth years will this take?

4 – The center of mass between two planets is the distance between them multiplied by the ratio of their masses. If the planets are 1 million kilometers apart, and their masses are 2 times Earth's mass and 5 times Earth's mass, how far from the larger planet is the center of mass?

Answer Key

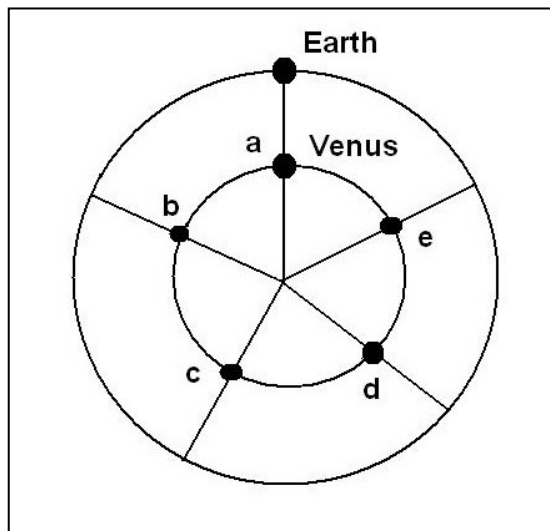
1 – The satellites of Jupiter, Ganymede and Europa, orbit the planet in 7.1 day and 3.5 days. About what is the ratio of the orbit period of Europa to Ganymede expressed as a simple fraction involving the numbers 1, 2, 3 or 4 in the numerator or denominator?

Answer: $3.5 / 7.1 = 0.49$ which is close to 0.5, so the nearest simple fraction is $1/2$.

2 – The planet Pluto orbits the sun in 248 years while Neptune takes 60 years. What is the simplest fraction involving the numbers 1, 2, 3 or 4 in the numerator and denominator that approximates the ratio of Neptune's period to Pluto's?

Answer: $164 \text{ years} / 248 \text{ years} = 0.66$. The closest ratio is $2/3$. This means that in the time it takes Pluto to orbit the sun twice, Neptune orbits almost exactly three times.

3 – Draw two concentric circles labeling the outer circle Earth and the inner circle Venus. Place a point on each circle at the 12 o'clock position, representing the two planets closest to each other. Venus and Earth are opposite each other in their orbits every $3/2$ of an earth year. During this time, Venus travels $6/5$ of its orbit around the sun. Where will the planets be after 5 opposition periods, and rounded to the nearest integer year, how many Earth years will this take?



Answer: The 5 opposition periods labeled a, b, c, d, and e in the diagram, form the sequence in earth years of $3/2$, $6/2$, $9/2$, $12/2$, $15/2$. The decimal values are 1.5, 3.0, 4.5, 6.0 and 7.5 years. During this time, Venus has moved $6/5$, $12/5$, $18/5$, $24/5$ and $30/5$ of its orbit. Eliminating full orbits, Venus has moved an extra $b = 1/5$, $c = 2/5$, $d = 3/5$, $e = 4/5$ and $a = 5/5$ and returned to its original position, a, after the 5th opposition. This happened 7.5 years after the opposition sequence started, which rounds up to 8 years later. Every 8 years, Earth and Venus will return to their start positions at the 12 o'clock position in the diagram.

4 – The center of mass between two planets is the distance between them multiplied by the ratio of their masses. If the planets are 1 million kilometers apart, and their masses are 2 times Earth's mass and 5 times Earth's mass, how far from the larger planet is the center of mass?

Answer: $1 \text{ million kilometers} \times 2/5 = 400,000 \text{ kilometers}$.